

April 2003



## Red River Valley Agricultural Research Center

### RESEARCH NEWS FROM THE VALLEY

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Red River Valley  
Agricultural Research Center  
Fargo, ND & East Grand Forks, MN

USDA-ARS-RRVARC

Fargo, ND

#### From the Director

It is hard to believe that we are already into Spring 2003. Several weeks ago we were moving snow and now we are preparing for the growing season here in eastern North Dakota and western Minnesota. Time does seem to fly by. I have a couple of items I want to briefly update you on, but first I want to thank all of the readers of the "Research News from the Valley" for your positive response to our efforts in keeping you informed of research being conducted on your behalf. I hope this current research update will be useful and will give you an idea of some of the key areas we are involved in.

As many of you know security in Federal facilities across the U.S. has significantly increased over the last 18 months. Here at the Center we have also experienced a marked increase in security awareness. In February we implemented enhanced procedures for visitors to enter our labs. We still require that you sign in/out and wear visitor badges while you are here. In addition, we now ask that non-citizens sign a separate entry

log. We have also been asked to not allow visitors from countries on the Department of State's list of State Sponsors of Terrorism. I know that at times these new procedures cause difficulties. I want to assure you, however, that we will continue to work with everyone to make sure that cooperation between our research partners is not significantly impacted because of these new procedures. We still welcome visitors under these new rules. Please give me a call if you have any concerns.

Several new facility related improvement projects are underway. The remodeling of a portion of the Biosciences Research Laboratory for the new small grains genotyping center is briefly mentioned in another part of this update. This remodel is moving quickly and we are hoping for completion in the summer. This will be a major asset for our Center when completed. Over the winter the remodel of one of our greenhouse ranges was completed and is also mentioned. Additionally, we are completing remodeling of

lab/office space for a portion of our Plant Science Research Unit and are planning remodels of some lab/office space within the Insect Genetics and Biochemistry, Sunflower, and Cereal Crops Research Units. We are excited about these new facilities and feel that they will enhance our research capabilities for many years to come.

Finally, thanks to everyone for your continued support of the Center. As you will see in the next few pages, our staff is exceptional and conducts outstanding research. Your support has enhanced their capacity to move programs forward and we certainly appreciate it.

We look forward to hearing from you. Have a great spring & summer!!

*Larry Chandler*

Center Director

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#### PASS IT ON!!!!

Feel free to pass on this issue of *News from the Center* to others interested in agricultural research in the Northern Plains Area.

To be added to our mailing list contact Alicia Meyers by phone (701-239-1370), fax (701-239-1395), or e-mail (meyersa@fargo.ars.usda.gov).

#### Biosensor Developed for Ractopamine in Livestock

Drs. Weilin Shelver and David Smith of the Animal Metabolism-Agricultural Chemicals Research Unit have developed a biosensor method which can determine levels of ractopamine (Paylean®, Elanco Animal Health, Eli Lilly and Co.) in cattle and sheep urine. Ractopamine is a feed additive approved for use in swine to promote growth and enhance lean cuts of meat. The biosensor detects

differences in light emitting from a minute gold chip to which ractopamine has been chemically attached when ractopamine antibody flows over the chip in the presence or absence of ractopamine. The results obtained from the biosensor correlated well with presently accepted methods available for the detection of ractopamine from sheep and cattle urine. This study shows that the biosensor assay is an excellent analytical tool to

determine ractopamine residues in sheep or cattle urine. Using this technology we should be able to detect ractopamine in other species. Further, it allows the development of an affordable instrument for immediate detection of ractopamine in animals in a slaughter facility.

For more information, contact Dr. Gerald L. Larsen, Research Leader, Animal Metabolism & Agricultural Chemicals Research Unit, at [larseng@fargo.ars.usda.gov](mailto:larseng@fargo.ars.usda.gov)

## Developing FHB-Resistant Durum



Head from an early generation cross of 'Ben' durum with wild emmer is on the left, a later generation hybrid is in the center, 'Ben' durum is on the right.

As many people in our region are aware, Fusarium head blight (FHB) is a very serious disease of wheat and barley that has caused damage estimated in the billions of dollars since 1993. Scientists in the Cereal Crops Research Unit have been employing a variety of approaches to develop FHB resistant barley and durum germplasm. One aspect of this program involves the use of classical plant breeding methods to introgress FHB resistance into durum via a wild relative. This plant, known as wild emmer,

or *Triticum turgidum* var. *dicoccoides*, has been crossed with Ben durum. Wild emmer is a sufficiently close relative of durum that this can easily be done. After the initial cross, a number of backcrosses to the durum parent are required to produce a plant that more closely resembles the durum parent. We now have relatively advanced plant populations that have good resistance to the spread of FHB within the head. Multiple genes have been found to be involved. Once the resistance is

stabilized, we hope to release FHB-resistant, strong gluten germplasm that can be used by breeding programs to eventually develop finished varieties. We expect this release in 2003. This work is a result of a strong collaboration between NDSU and ARS scientists.

For more information, contact Dr. Michael C. Edwards, Research Leader, Cereal Crops Research Unit, at [edwardsm@fargo.ars.usda.gov](mailto:edwardsm@fargo.ars.usda.gov)

## Water Stress Leads to Potato Sugar-end Defect



Effects of storage recondition on sugar-end severity (top row: no treatment, bottom row: reconditioned).

Postharvest storage losses cost the potato industry hundreds of millions of dollars annually. One of the more serious physiological disorders affecting potato market quality is sugar-end defect. Sugar-end defect is a result of pre-harvest field stress that predisposes potatoes to accumulate excessive levels of reducing sugars during storage which in turn leads to chip darkening during processing. Because of its uncertain origin and unpredictable occurrence,

little was known about the causes and management of this disorder. In a collaborative research effort by scientists from the ARS East Grand Forks Potato Research Worksite, University of Minnesota, North Dakota State University, and the University of Minnesota Extension, it has been found that water stress at specific stages of tuber development is a principal factor in the subsequent development of this disorder. Other studies by this group have found that the

severity of sugar-end defect can be dramatically reduced by modifying postharvest storage conditions in a process known as reconditioning (see bottom right panel, figure below). Additional research is being conducted to further optimize storage conditions to minimize the economic impact of this disorder on the potato industry.

For more information, contact Dr. Jeffrey C. Suttle, Research Leader, Sugarbeet & Potato Research Unit, at [suttlej@fargo.ars.usda.gov](mailto:suttlej@fargo.ars.usda.gov)

## Weed Seed Dormancy



Wild Oats

Weeds like wild oat are difficult to control because seeds escape many conventional control measures by remaining dormant in the soil. Dr. Mike Foley, Plant Science Research Unit, in collaboration with scientists at North Dakota State University recently constructed a rudimentary genetic linkage map of wild oat that will be used to mark quantitative trait loci or genes for dormancy on the chromosomes of wild oat. Mapping involves dividing

chromosomes into smaller fragments using DNA markers that describe the order of genes or other markers and the spacing between them on each chromosome. A genetic linkage map depicts the relative chromosomal locations of DNA markers, that is genes and other identifiable DNA sequences, by their patterns of inheritance. Any inherited physical or molecular characteristic, such as dormancy, that differs among individuals and is easily

detectable is a potential genetic marker. The wild oat linkage map contains 165 loci with 31 linkage groups covering 580 cM. This activity is an important first step in elucidating dormancy mechanisms to develop alternative weed control measures aimed at dormant weed seeds.

For more information, contact Dr. Michael E. Foley, Research Leader, Plant Science Research Unit, at [foleym@fargo.ars.usda.gov](mailto:foleym@fargo.ars.usda.gov)

## Whitefly Feeding Behavior

The silverleaf whitefly first became a serious pest and reached very high population levels across the southern United States in the early 1990s. These insects are more vigorous than other biotypes and can cause near total crop loss in cotton, melons, squash, tomatoes and other vegetables. They have a wide range of plant hosts, including alfalfa and carrots, and reduce plant yield directly by removing plant sap through their ability to feed deep into the leaf, and by transmitting plant viruses. Understanding the manner in which these insects penetrate plant tissue to feed and lay eggs may be useful to plant

breeders in developing new varieties with morphological characteristics that may impart resistance to the pest. Scientists in the Insect Genetics & Biochemistry Research Unit were asked by ARS to study this phenomena as part of a national program to address this important issue. Drs. James Buckner and Dennis Nelson, ARS, and Dr. Thomas Freeman, North Dakota State University, demonstrated that the mouthpart stylets of the immature whiteflies, crawlers and nymphs, are long enough to reach a phloem bundle on which to feed, from any position on the leaf. These findings reversed long-held

beliefs that the smallest nymphs were limited in their ability to reach phloem and needed to have thin leaves and to use leaf surface morphology to locate a suitable site on which to begin probing the leaf. This information was provided to entomologists and plant breeders who must find other indicators of potential resistance which could lead to the development of plant varieties that resist this feeding behavior and provide long-term management of the pest.

*For more information, contact Dr. Dennis R. Nelson, Research Leader, Insect Genetics & Biochemistry Research Unit, at [nelsond@fargo.ars.usda.gov](mailto:nelsond@fargo.ars.usda.gov)*



Silverleaf Whitefly

## Sunflower Research Expands to Central Plains

In recent years acreage of sunflower production has greatly expanded in the Central Plains region of the United States into the states of Nebraska, Colorado, and especially Kansas. Unfortunately, the insect problems that plague the sunflower crop have also invaded this region. One pest, the sunflower moth, deposits eggs on the sunflower heads and the developing larvae consume the seeds, reducing yield. In addition, two other pests infest the sunflower stem and can cause the plants to lodge or fall over before harvest. These include the sunflower stem weevil and the long-horned sunflower stem girdler. In 2001, Larry Charlet, the Sunflower Research Unit entomologist, was asked to assist in developing management solutions to these problems. Initial efforts

were directed to the sunflower stem weevil to evaluate germplasm that might offer resistance to this pest, to determine if altering planting dates could reduce damage, and to determine the best timing for insecticide treatment when it is required. Jerry Miller, Research Geneticist, and Gerald Seiler, Botanist, joined the research effort in 2002 to evaluate sunflower germplasm for resistance to these pests. The team evaluated ARS sunflower lines, interspecific crosses, and germplasm from the USDA, ARS, Plant Introduction Station at Ames, Iowa, to search for lines offering resistance to the sunflower moth, the sunflower long-horned stem girdler, and the sunflower stem weevil. Once identified, this germplasm can then be incorporated into sunflower

breeding lines to reduce economic losses from insect damage in the central Great Plains. In conjunction with these studies, the species of parasitoids attacking the insect pests and their relative impact is also being evaluated to ensure that any promising germplasm identified with resistance to the pest is not detrimental to natural enemy activity.

*For more information, contact Dr. Brady A. Vick, Research Leader, Sunflower Research Unit, at [vickb@fargo.ars.usda.gov](mailto:vickb@fargo.ars.usda.gov)*



Entomologist, Larry Charlet, examines sunflowers for insect pests.

## Dr. James Miller Retires

Dr. James D. Miller, Plant Pathologist, Cereal Crops Research Unit, Fargo ND, retired January 3rd, 2003 after almost 47 years of federal service with ARS.

Dr. Miller earned his B.S. in Biology at Hamline University in St. Paul, MN. He joined ARS in 1956 as a wheat stem rust pathologist in the USDA Cereal Rust Laboratory at the University of Minnesota. Jim attended graduate school part-time while working full-time. He completed his Ph.D. dissertation at the University of Minnesota on phenotypic variability within the wheat stem rust fungus.

In 1965, he was transferred to the Federal Experiment Station, Mayaguez, Puerto Rico, to be in charge of cereal rust investigations. In 1968, as the cereal rust program in Puerto Rico was beginning to be phased out, Dr. Miller was transferred to Fargo, ND, where he continued to work on stem rust problems. He is well-known nationally and internationally as an authority on wheat stem rust and is

especially well-known for his contributions toward genetic control of stem rust in hard red spring and durum wheats grown in the Northern Great Plains of the U.S.

One of his major interests has been in developing and using orange, gray brown, and white stem rust color spore mutants individually or mixed with normal reddish-brown spore cultures for detecting, without crossing, the presence of new resistance genes in wheat and alien species, and for accelerating a gene pyramiding breeding scheme for rust resistance. He showed that the amount of genetic information could be doubled in the F2 progeny tests and that predictions of similar and different genes within the alien species could be made when using mutant/normal spore mixtures.

Jim has played a significant role in the development and release of stem rust resistant bread and durum wheats. He recognized, selected, and provided stem rust test cultures that were used in

identifying lines with multiple resistance genes which ultimately became 49 North Dakota durum, spring bread wheat, and winter bread wheat cultivars. Continual pyramiding of rust resistance genes in these wheats has prevented severe stem rust epidemics and yield losses.

In 1999, Dr. Miller shifted some of his research effort to developing Fusarium head blight (FHB) resistant durum. In cooperation with Drs. Bob Stack and Leonard Joppa, he identified several accessions of wild emmer with FHB resistance. Results from FHB tests of disomic chromosome substitution lines show that chromosomes 3A, 5B, 7A, and 7B are sites of FHB resistance genes. A cross between a chromosome 7A substitution line and durum cultivar Ben was made and preliminary germplasm selections are being screened for FHB severity. Jim will be collaborating on the completion of this project even after retirement.



Dr. Jim Miller at his retirement party that was held January 31, 2003, at the Northern Crop Science Laboratory.

## Sclerotinia Initiative Update

The Sclerotinia Initiative continues to grow. Funding increased to approximately \$1.4 million for 2003. The canola, dry edible bean, pea & lentil, soybean, and sunflower commodity groups continue to be fully supportive of this important research activity. The first Annual Meeting of the Initiative was held in Bloomington, MN on Jan. 21 & 22, 2003. Over 60 cooperating scientists attended and presented

updated research summaries from projects funded in 2002. Additionally, the group spent a significant portion of their time developing and prioritizing research needs for the coming year. On March 13 the Initiative Steering Committee met to make funding decisions for 2003 research projects. A total of 23 research plans received some funding support. To date the Initiative has been extremely successful and is an

outstanding example of research cooperation between numerous ARS laboratories, universities, and industry partners. We expect to see continued program growth and outstanding results in the months to come.

For more information, contact Dr. Laurence D. Chandler, Center Director, at [chandlerl@fargo.ars.usda.gov](mailto:chandlerl@fargo.ars.usda.gov)



First Annual Sclerotinia Meeting attendees.

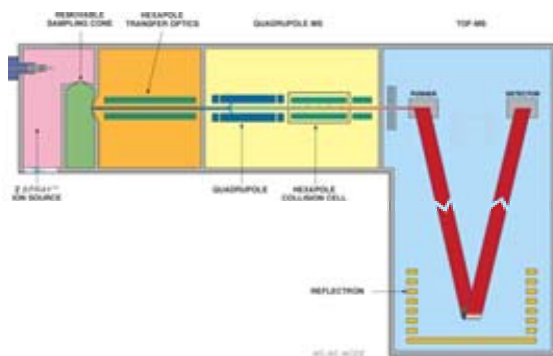
## New Equipment for Animal Metabolism

The Animal Metabolism - Agricultural Chemicals Unit was able to acquire a state-of-the-art Liquid Chromatography/Quadrupole Time of Flight Mass Spectrometer (LC/QTOF) with proteomics at the beginning of 2003. Addition of this analytical capability allows the Unit to stay current with Agricultural Chemical and Human Drug companies engaged in metabolism and disposition of agriculturally related chemicals. LC/QTOF offers the Unit the following analytical capabilities:

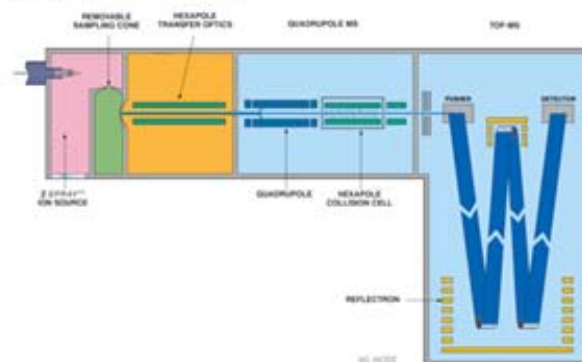
- 1) identification and detection (elemental composition by

- exact mass measurements to 5 ppm) of natural and man-made chemicals in foods; 2) increase in sensitivity for analysis of natural toxins (ergopeptide alkaloids) and feed contaminants (illegal drugs or sabotage agents) of food safety concern; 3) detection and unambiguous identification of unstable or reactive metabolites; 4) identification of large molecules like proteins (i.e. sequence data) involved in the metabolism of foreign compounds or designed for use in receptor-based screening assays; 5) unambiguous identification of natural or

- man-made contaminants and their metabolites in food; and 6) direct detection of large protein toxins (e.g. botulism causing toxin) in food. Other benefits this instrument will provide for the entire Center include: 1) reduced dependence on radiotracers, through use of stable isotopes ( $^2\text{H}$ ,  $^{13}\text{C}$ ); 2) support for protein (and DNA) sequencing; and 3) implementation of "Chemical fingerprint" pattern recognition based [system] typing.



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Completed J range cells in use.

## NCSL Greenhouse & BRL - Bldg 5 Remodeling for Cereals

The recent growth of our research programs provides great opportunities to better serve the needs of our customers, but also places new demands on our facilities. Fortunately for the Center, we have also received new funding enabling us to make facility improvements.

One project recently completed involved a significant improvement in some of our greenhouse facilities. Although the Northern Crop Science Laboratory 'J' Range greenhouse was built to accommodate as many as ten individual rooms, only two

were built at the time of construction. The remainder of the space was left as an open area and shared by multiple research projects. A renovation project to partially subdivide this space was completed in February. The addition of two new rooms greatly improves the usability and quality of this space by allowing better plant isolation and temperature control.

A major renovation project is currently underway at the Biosciences Research Laboratory. When construction is complete, we will have two new laboratories (each approx. 600 sq. ft.), two

offices, storage areas, and additional greenhouse space where part of the old screwworm project was once housed. In addition, hallways in the area will be renovated and rerouted to provide better access to both the new facilities and the frog research area. The new facilities will house the Small Grains Genotyping Laboratory recently funded by Congress to facilitate the use of molecular marker technologies for small grains improvement.

Greenhouse During Remodeling



Greenhouse After Remodeling



## USDA East Grand Forks Potato Research Worksite Tour

The East Grand Forks Potato Research Worksite (PRW) hosted a tour of the chip/fry/flake pilot plant facility for the Fargo members of the Sugarbeet & Potato Research Unit. PRW staff demonstrated chip line operation and described french fry line and flake processing procedures. Methods of potato product quality assessment were described as were the postharvest potato storage

capabilities. The tour also included the newly constructed mid-scale environmental control storages and the seed storage and potato grading equipment maintained by University of Minnesota cooperators. The tour was followed by a luncheon at the PRW. Unit members then traveled to the R.D.O. potato flake plant in Grand Forks for a guided tour of an industrial scale potato

processing plant. For many unit members, this was the first opportunity to visit our sister lab in East Grand Forks and witness PRW operations.



Marty Glynn describes pilot plant operations.

## NCSL History



### Northern Crop Science Laboratory

The Northern Crop Science Laboratory (NCSL) was first conceived in the Fall of 1982. Plant biotechnological research involving sunflower, sugarbeets, and small grains was clearly identified as an area of research that needed new facilities to enhance cooperative efforts between state and federal scientists. North Dakota State University (NDSU) President L. D. Loftsgard and Dean H. R. Lund approached the local Congressional Delegation (Senator Andrews) about this need which resulted in a feasibility study and architectural designs being authorized in 1983 and completed in 1985. ARS was designated as the agency responsible for the project when the feasibility study was approved. Dr. Claude Schmidt, Director of the USDA-ARS Metabolism and Radiation Research Laboratory in Fargo (currently the Biosciences Research Lab) and Dr. T. Ross Wilkerson, Assoc. Dean, NDSU College of Agriculture, were selected as the co-chairmen of the building project. The original plans called for the facility to accommodate 21 scientists, including 6 from NDSU. Cost for the facility was approved at \$9.1 million and included a research facility complex attached to the north side of the existing Plant Science Greenhouse ranges and 2 new ranges added to the south side of the existing greenhouses. The final facility design included an interconnected complex of one and two-story buildings which won numerous architectural awards. The new building included lab and office space, a building for seed cleaning, drying and storage, and a single story maintenance building with growth chambers. It was completed in 1988 and was dedicated on September 2, 1988. Currently the NCSL houses portions of the ARS Cereal Crops, Sugarbeet and Potato, and Sunflower Research Units which include 19 scientists, numerous postdocs and students, and over 20 research support staff. Today these individuals conduct cutting edge research resulting in improved germplasm for wheat, barley, sugarbeets, and sunflower. Additionally, high priority research is conducted to develop new pest management methods for the above crops and to improve storage characteristics of sugarbeets and potatoes. The NCSL also houses the state-of-the-art NDSU Electron Microscope Laboratory under the direction of Dr. Tom Freeman. The addition of the NCSL to the NDSU campus enhanced cooperation between ARS and university scientists working on numerous collaborative research projects of interest to both institutions. This cooperation is stronger than ever in 2003.



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## RED RIVER VALLEY

## AGRICULTURAL RESEARCH CENTER

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### EVENTS AT THE CENTER

#### MAY 2003

19: Dr. Xingyou Gu, NDSU postdoc with USDA-ARS Plant Science Research Unit, "Rice Seed Dormancy: Inheritance, Evolution & Quantitative Trait Loci", Fargo, ND.

#### JULY 2003

Dr. Xiwen Cai, North Dakota State University, Dept. of Plant Sciences. TBD.

#### FALL 2003

Research Partners Meeting

### Upcoming Events

On-Site Review of Insect Genetics & Biochemistry Research Unit

On-Site Review of Plant Science Research Unit

### EVENTS ELSEWHERE

#### MAY 2003

6-7: AACC Milling & Baking Div. Spring Technical Conf. & Food Conf.; Mpls, MN.

28-29: 2003 Southern Plains Ag. Res. Ctr. Food Safety Research Mtg.; College Station, TX

31-June 4: 2003 Congress on In Vitro Biology; Portland, OR.

#### JUNE 2003

4-8: NPLC's 2003 Biochemistry & Molecular Biology of Plant Fatty Acids & Glycerolipids Symp.; Fallen Leaf Lake, CA.

17-19: 2nd Intl Aphanomyces Symposium; Pasco, WA.

19: Watershed Heros Core4 Conf. & Natl. Eco-Team Competition; St. Peter, MN.

21-29: 7th Intl. Congress of Plt. Molecular Biology; Barcelona, Spain.

22-23: Natl. Sunflower Assn. Summer Seminar; Bismarck, ND

#### JULY 2003

6-12: XIX Intl. Congress of Genetics; Melbourne, Australia.

24: NPPGA Field Days; Tappen, ND.

26-30: Annual American Society of Plant Biologists; Honolulu, HI.

26-31: Annual Mtg. of the Botanical Soc. of America; Mobile, AL

30: Nebraska Leafy Spurge Taskforce Mtg.; Chadron, NE.

31: NPPGA Field Days - Research Farm; Grand Forks, ND

#### AUGUST 2003

6-8: SD Plant Physiology/Plant Biochemistry Symp.; Brookings, SD.

9-13: American Phytopathological Society Natl. Mtg.; Charlotte, NC.

10-14: Potato Assn. of America; Spokane, WA.

24-29: 23rd Intl. Symp. On Halogenated Environmental Organic Pollutants and POPs (Dioxin 2003); Boston, MA.

#### SEPTEMBER 2003

1-6: 10th Intl. Wheat Genetics Symp.; Paestum, Italy.

7-11: American Chemical Soc., Natl. Mtg., Agrochemical Div.; New York City, NY.

10-13: 7th Intl. Conf. on Agri-Food Antibodies; Uppsala, Sweden.

29-Oct. 2: AACC Annual Mtg.; Portland, OR